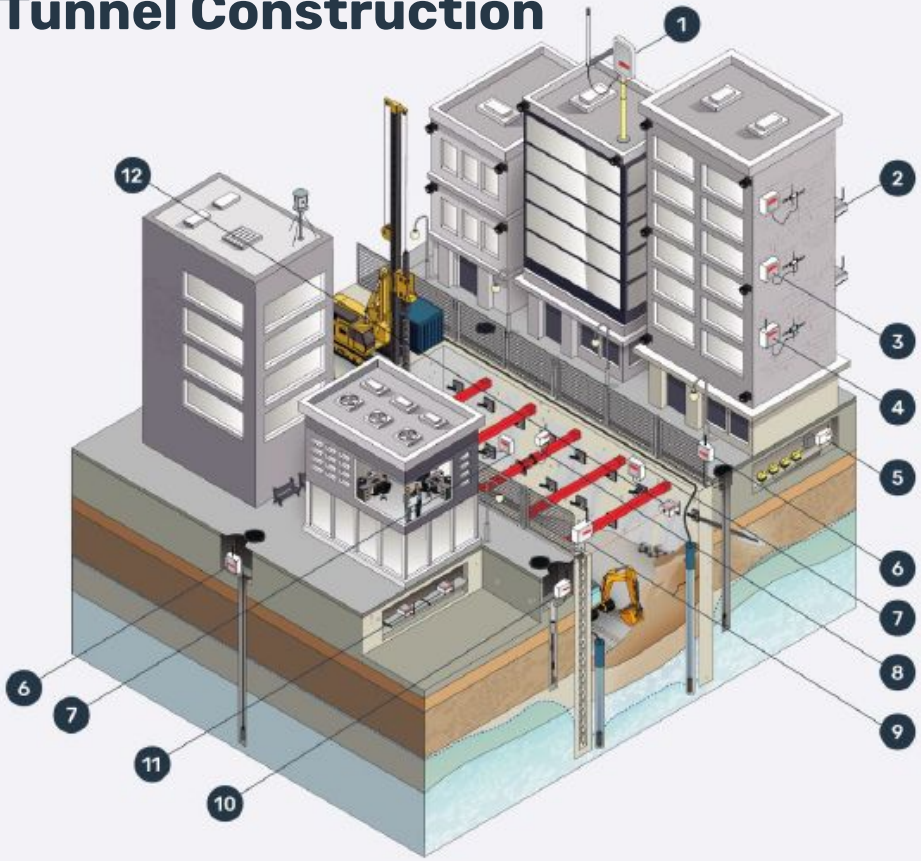
IoT Wireless Monitoring In Tunnel Construction



1 Gateway

2 Wireless Tiltmeter installed using a vertical mounting bracket

An integrated biaxial inclinometer that serves as a 2-in-1 sensor and node used to measure tilt, building response to tunneling, angular distortion or horizontal displacement

3 Piconode Analog 1 channel

Connected to a crackmeter or displacement sensor (potentiometer) to measure movement across surface cracks and joints and building response to tunneling

4 Vibrating Wire Node 1 channel

Connected to a crackmeter or displacement sensor (vibrating wire) to measure movement across surface cracks and joints and building response to tunneling

5 Analog Node 4 channels

Connected to a liquid level settlement cells to measure settlement and heave or building response to tunneling

6 Vibrating Wire Node 1 channel

Connected to a piezometer (vibrating wire) to measure groundwater level and pore water pressure

7 Piconode Analog 1 channel

Connected to a load cell to monitor the force in ground anchors

8 Vibrating Wire Node 5 channels

Connected to strain gauges (vibrating wire) to measure strain and stresses in structural members

9 Digital node

Connected to an in-place inclinometer (IPI) on a chain in a hole or excavation to measure lateral deformation in diaphragm walls or lateral ground movement to monitor performance of structural members and movement behaviour of soil

10 Vibrating Wire Node 5 channels

Connected to Multipoint Borehole Extensometers or MPBX (vibrating wire) to measure ground movement behind diaphragm wall or vertical deformation at various depths

11 Wireless Tiltmeter attached to a rigid beam and installed on a chain

An integrated biaxial inclinometer that serves as a 2-in-1 sensor and node used to measure settlement and heave or building response to tunneling

12 Laser Distance Node

An integrated laser distance meter node that serves as a 2-in-1 sensor and node used for convergence measurement in the excavation walls